ONTOLOGIES FOR MATERIALS, COMPONENTS, HVAC EQUIPMENT

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Sustainable Places 2022,
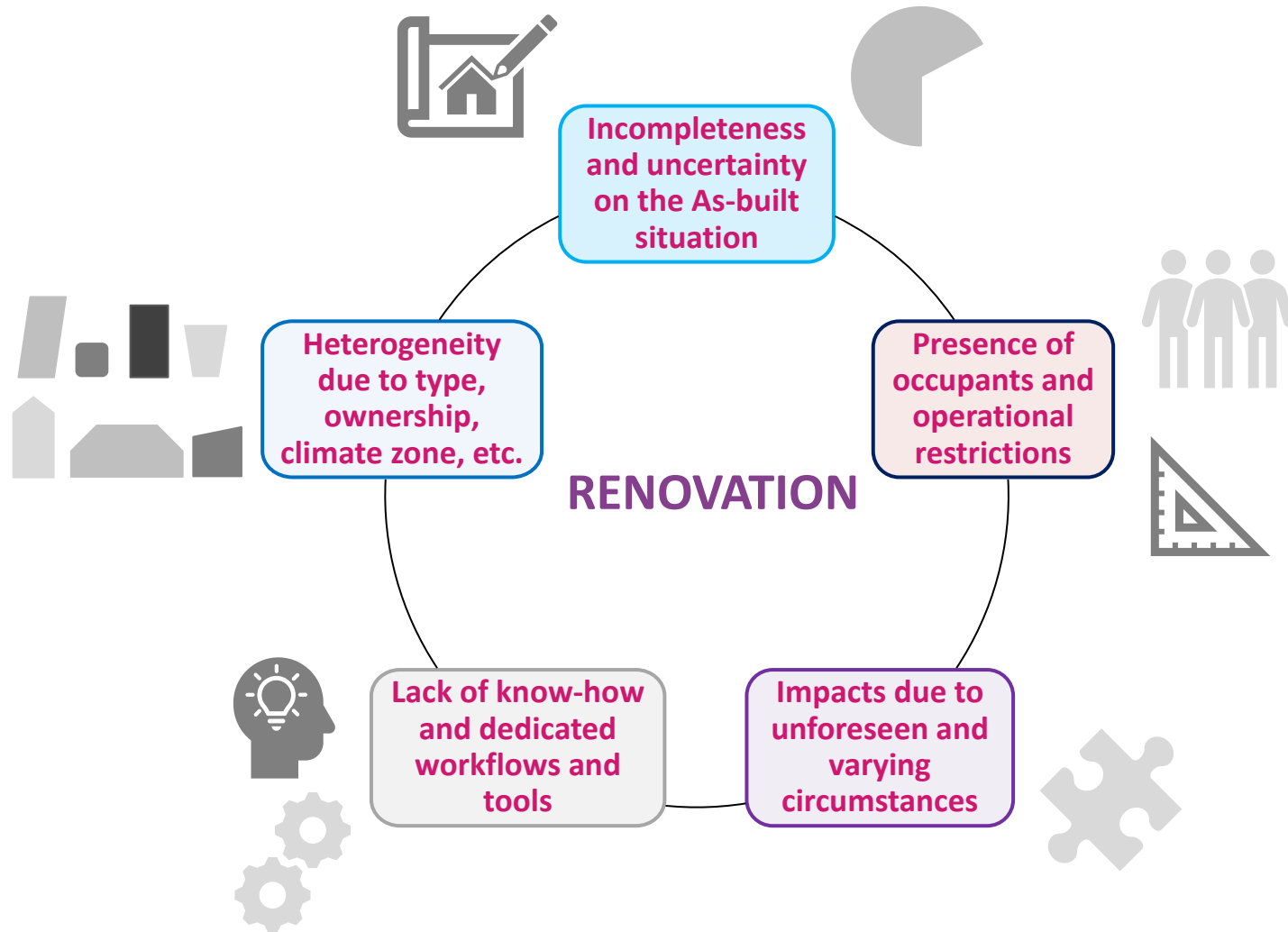**Nice 07.09.22**

CONTENT

- Renovation projects

- Knowledge representation

- BIM-SPEED Knowledge models and methodology

- Exemplification: The Reno-Inst Ontology

A CLOSER LOOK TO RENOVATION PROJECTS AND KNOWLEDGE REPRESENTATIONS

RENOVATION PROJECTS

Incompleteness and uncertainty on the As-built situation

Presence of occupants and operational restrictions

Heterogeneity due to type, ownership, climate zone, etc.

RENOVATION

Lack of know-how and dedicated workflows and tools

Impacts due to unforeseen and varying circumstances

WHAT IS A KNOWLEDGE REPRESENTATION?

A set of symbols and text that describe some information domain, it is a tool that helps stakeholders better understand a set of attributes and business rules [1].

An ontology is a representation that explicitly specifies concepts, terminologies, and relationships that are known in a particular domain. Establishing a common vocabulary for users, including machine-interpretable definitions of basic concepts in the domain and relations among them [2].
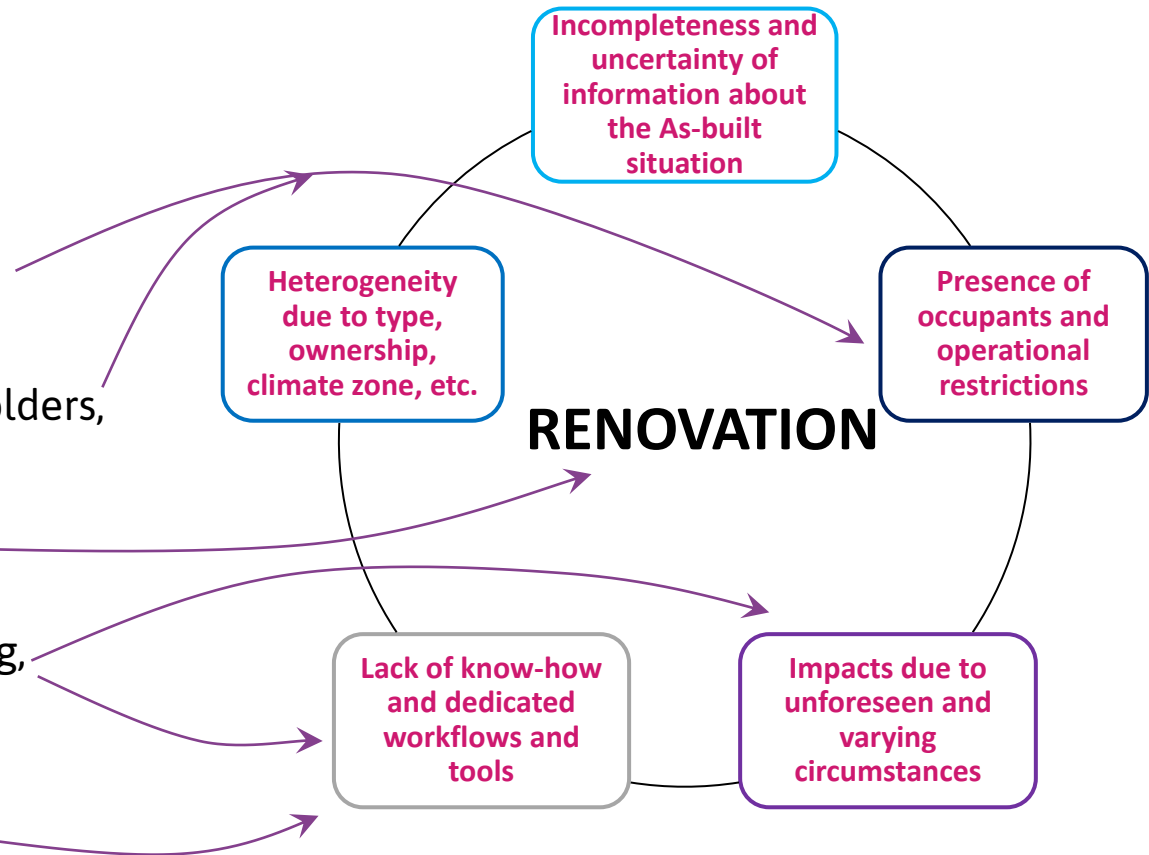
[1]. M. Uschold, M. and Gruninger, Ontologies: principles, methods and applications, Knowl. Eng. Rev. 11 (1996) 93-136.
[2]. N. Noy, D. Mcguinness, Ontology development 101: A guide to creating your first ontology. Knowledge Systems Laboratory 32, 2001.

WHY FOR RENOVATION?

An ontology can improve:

- The consistency and lack of ambiguity,

- Interaction between stakeholders,

- Interoperability,

- Knowledge reuse and sharing,

- and enable more reliable computational tools [2].

Incompleteness and uncertainty of information about the As-built situation

Heterogeneity due to type, ownership, climate zone, etc.

Presence of occupants and operational restrictions

RENOVATION

Lack of know-how and dedicated workflows and tools

Impacts due to unforeseen and varying circumstances

[2]. N. Noy, D. Mcguinness, Ontology development 101: A guide to creating your first ontology. Knowledge Systems Laboratory 32, 2001.

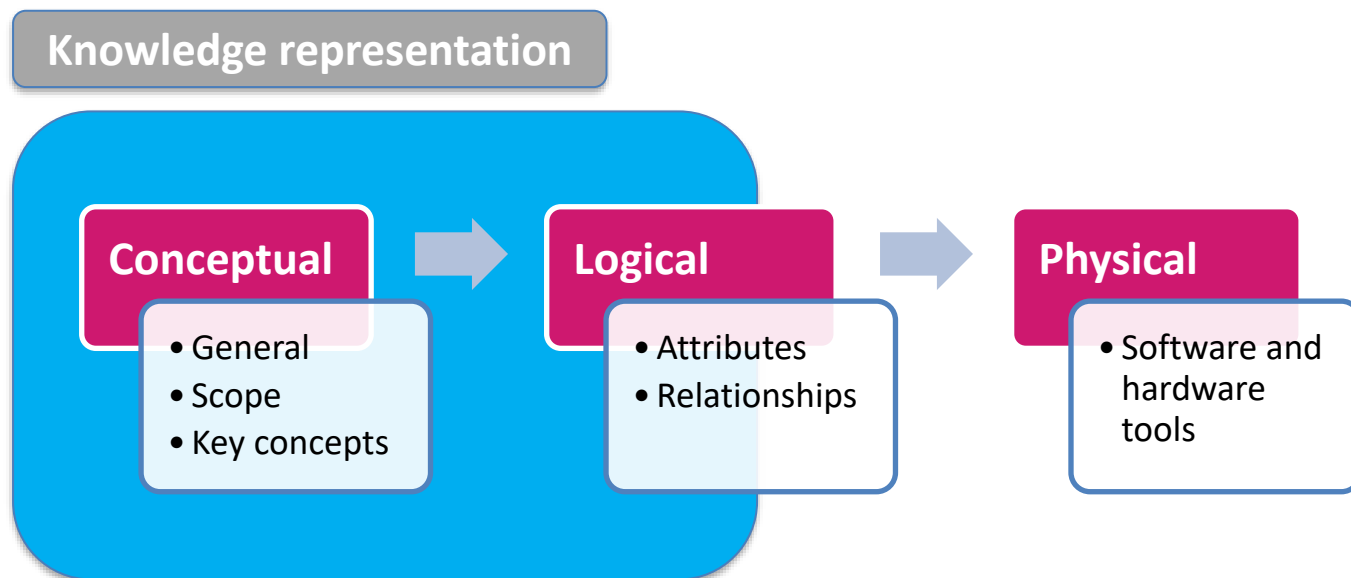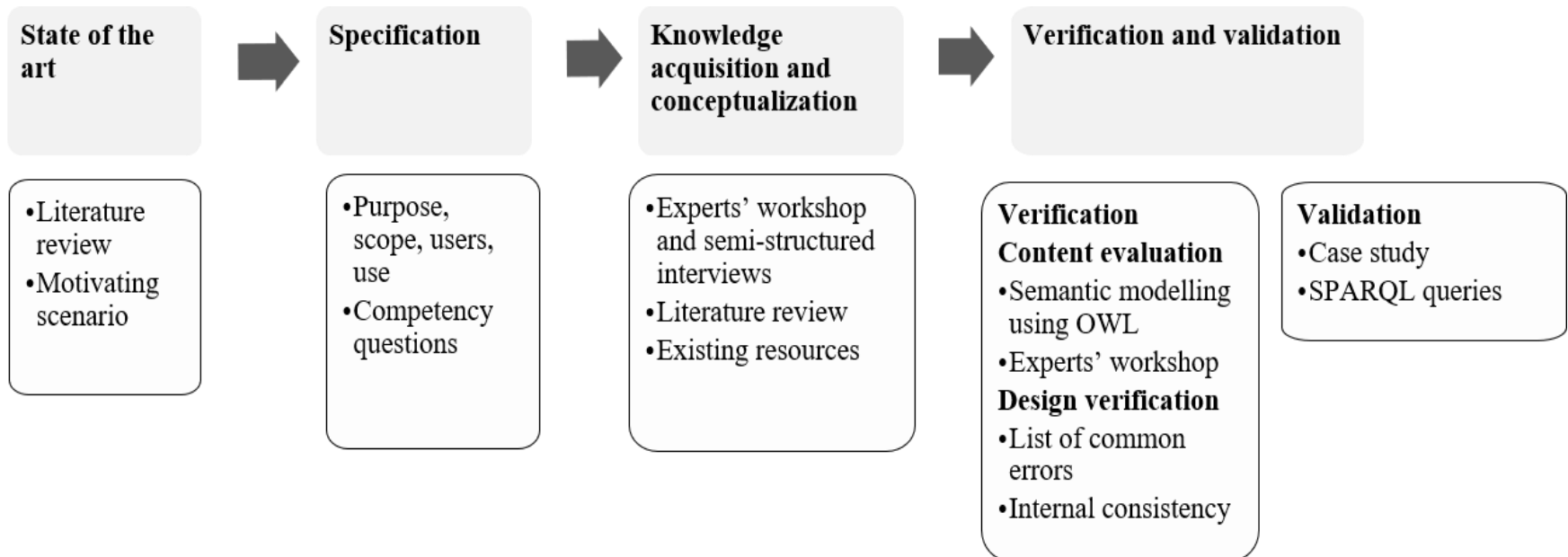# KNOWLEDGE MODELS AND METHODOLOGY

FOCUS OF THE INITIATIVE

Figure 1. Knowledge representation

METHODOLOGY

Figure 2. Methodology

ONTOLOGIES

Renovation planning?

LCA/C analysis of potential alternatives

BEM model? …From BIM to BEM

Is it the surrounding relevant?

Reno-Inst	LCA-C	BEM-Reno	GIS-Based

Reno-Inst
- Existing guidelines
- Expert's workshops and interviews

LCA-C
- Previous research initiatives
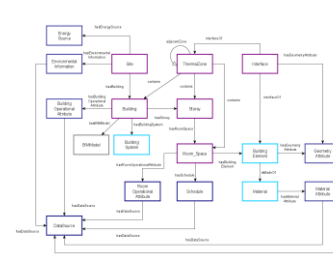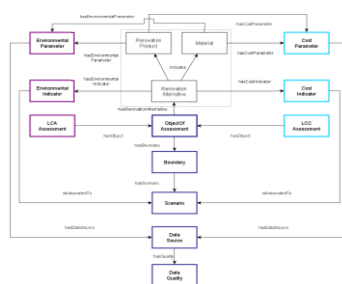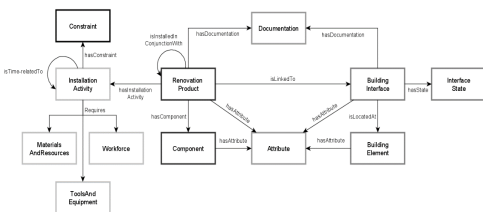- Standards such as EN 15978

BEM-Reno
- Existing BIM to BEM workflows
- Previous research initiatives
- Existing ontological resources

GIS-Based
- Use cases
- Related literature
- Existing GIS representations
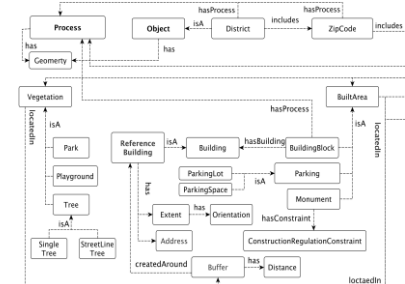
RENO-INST ONTOLOGY

AN ONTOLOGY TO SUPPORT RENOVATION PROJECTS PLANNING AND RENOVATION PRODUCTS INSTALLATION

RENO-INST: SPECIFICATION

- **What is the purpose?**

The Reno-Inst ontology is developed to represent concepts related to **requirements, constraints, and the installation of renovation products** to support planning and execution tasks in building renovation projects.

- **What is the scope?**

The ontology covers concepts and relations regarding **the installation of windows, ETICS panels, and radiators**, which are common renovation products. The ontology includes information on **physical features, general installation procedures, constraints** that should be considered, and additional elements such as workforce, time, and tools requirements.

RENO-INST: SPECIFICATION

- *What are the intended end-users?*

The final intended users are **project managers, site-directors, and other stakeholders** which are involved in the **planning and execution** of construction activities in building renovation projects.

- *What is the intended use?*

To assist stakeholders during the planning and execution phases of renovation projects, **facilitating the retrieval of installation information for different purposes**. For instance, a user can list **the tools and materials** required to install a window. A user can also verify whether a specific construction task can be performed in **the presence of occupants**.
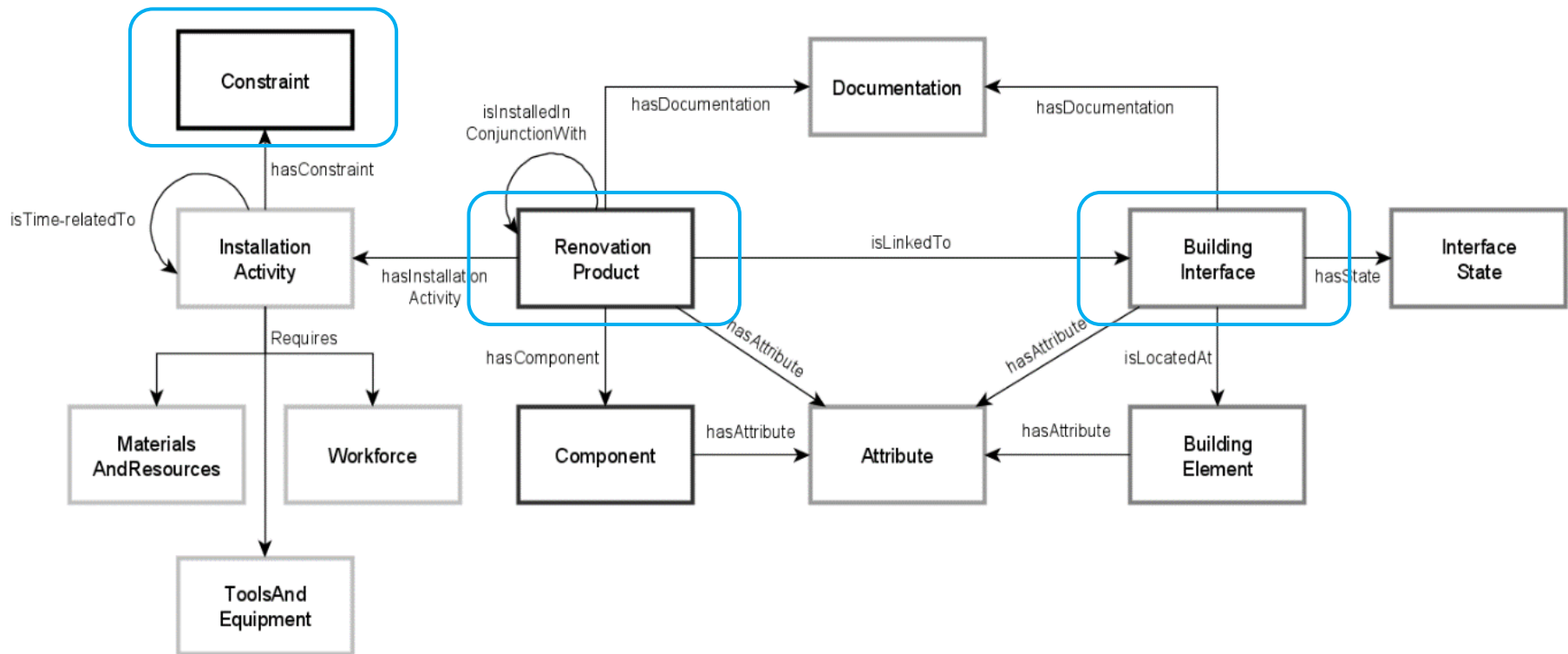
RENO-INST: OVERVIEW

Figure 3. Reno-Inst ontology overview

J.A.P Amorocho, T. Hartmann, Reno-Inst: An ontology to support renovation projects planning and renovation products installation, Advanced Engineering Informatics, Volume 50, 2021, 101415, ISSN 1474-0346, https://doi.org/10.1016/j.aei.2021.101415.

RENO-INST: SPARQL QUERIES

SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX reno: <http://www.systemsEngineering.org/jersonpinzon/Reno-Inst.owl#>
SELECT ?ETICS_Panel ?RenovationProduct
            WHERE { ?ETICS_Panel rdf:type reno:ETICS_Panel.
```

SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX reno: <http://www.systemsEngineering.org/jersonpinzon/Reno-Inst.owl#>
SELECT ?ETICS_Panel ?InstallationActivity ?Constraint ?Description
            WHERE { ?ETICS_Panel rdf:type reno:ETICS_Panel.
                    ?ETICS_Panel reno:hasInstallationActivity ?InstallationActivity.
                    ?InstallationActivity reno:hasConstraint ?Constraint.
                    ?Constraint reno:hasDescription ?Description}
```

ETICS_Panel	InstallationActivity	Constraint	Description
thermal_classic_mineral_panel	Removal_gas_pipelines	basic_services_interruption	"When basic services such as water or gas are interrupted by an activity. A notification should be send to the occupants 48 hours previous the starting of the activity"

Figure 4. Reno-Inst ontology queries

FINAL REMARKS

- Knowledge representations can be the starting point to formalize **information requirements** from the renovation domain, develop **dedicated tools** to support specific tasks within renovation projects, and **support interoperability** between the diverse information sources available in these projects.

- The description of the ontological models is available within **Deliverable 2.2** on the **BIM-SPEED website**

- Potential future research activities include:
  - Validating the additional knowledge models
  - Further development of the models' documentation and description

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COLOPHON